§2. Study of Impurity Ion Radiation Intensity in the GAMMA 10 Plasma

Yoshikawa, M., Kubota, Y., Kobayashi, T., Saito, M., Nakashima, Y. (Univ. Tsukuba, PRC)
Kato, T., Murakami, I., Goto, M.

Time and space resolved spectroscopic measurements of radiation spectra from a plasma give us a lot of important information, such as time and space variations of plasma density, electron and ion temperatures, etc. After comparing the collisional-radiative model (CR-model)[1] calculation results for impurity ion line radiation and neutral hydrogen line emission intensities and those measured by spectroscopic method, we can obtain the impurity ion densities, electron density and electron temperature. The aim of this study is to construct the database of the absolute impurity ion and neutral hydrogen emissions and the CR-model for plasma spectroscopic diagnostics in the fusion plasmas.[2-3] Moreover, the neutral particle behavior is studied by using CR-model and multi-channel H_α line emission detection systems in GAMMA 10.[4]

We have constructed the H_α line emission detection systems in each cells of GAMMA 10. In this year, the 5-channel H_α line emission detection systems are newly installed in the central throat and the barrier cell. Figure 1 shows the time dependence of H_α line emission radial profile in the barrier cell of GAMMA 10. Then the absolute H_α line emission radial profiles in each cell of GAMMA 10 are obtained in order to study the neutral particle behaviors and particle balances in the GAMMA 10 plasma.

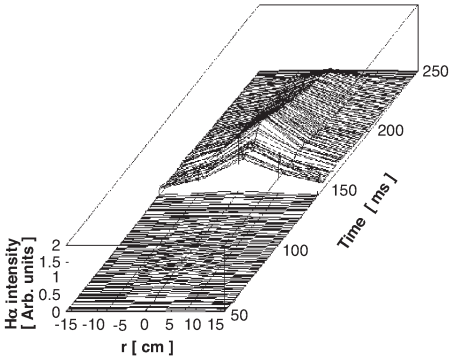

Fig. 1: Time dependence of H_α line emission radial profile in the barrier cell of the GAMMA 10.

CR-model calculation codes for carbon and oxygen ions developed in NIFS were used in this study.[1] We applied CR-model calculation results to observed impurity spectra in the GAMMA 10 tandem mirror to evaluate the impurity density profile and the particle balance of each charge state of carbon ion. We obtained CII and CIII density profiles by measured spectra and effective population rate coefficients. Moreover, we considered particle balance of each charge state of carbon ion, and estimate carbon ions density profiles with ionizing plasma approximation with considering the mirror confinement time. We calculated the effective ionization rate for each charge state of carbon ion and obtained the density profile of each ion. Figure 2 shows the density profiles of electron and each charge state of carbon ion estimated by the particle balance. Moreover, we calculated absolute emission intensities from all carbon ions. The result of our estimation showed that CV is dominant in the center of plasma and CIV is comparable to CIII in edge region. Then CIV spectrum (154.8 nm) is expected to emit the strongest in all carbon spectra.

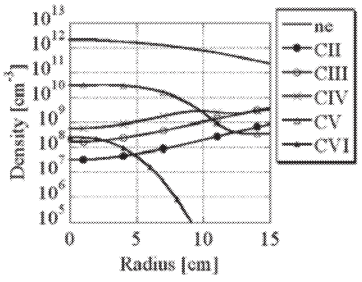

Fig. 2: Density profiles of electron and each charge state of carbon ion estimated by the particle balance.

Reference

1) Kato, T., et al.; Fusion Eng. Des, **34-35** (1997) 789.
2) Yoshikawa, M., et al.; Annual Report of NIFS, April 2001-March 2002 (2002) 374.
3) Yoshikawa, M., et al.; Annual Report of NIFS, April 2003-March 2004 (2001) 415.
4) Yoshikawa, M., et al.; Transactions of Fusion Science and Technology, **43** (2003) 189.